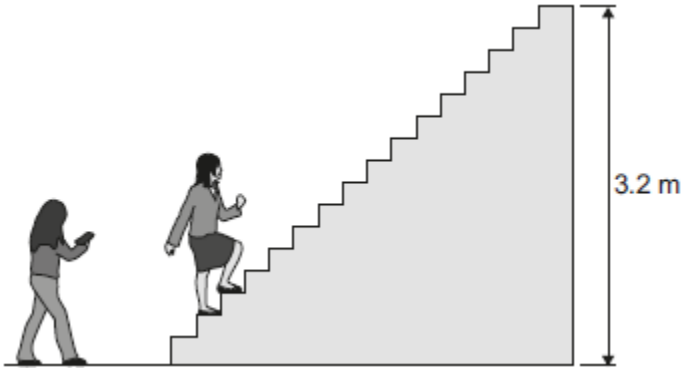
1 A student did an experiment to calculate her power.
The diagram below shows how she obtained the measurements needed.

The student first weighed herself and then ran up a flight of stairs. A second student timed how long it took her to go from the bottom to the top of the stairs. The height of the stairs was also measured.



(a) Complete the following sentence.

To run up the stairs the student must do work against

the force of _____ .

(1)

(b) The student did 2240 J of work going from the bottom of the stairs to the top of the stairs.

The student took 2.8 seconds to run up the stairs.

(i) Calculate the power the student developed when running up the stairs.

_____

_____

Power = _____ W

(2)

(ii) How much gravitational potential energy did the student gain in going from the bottom to the top of the stairs?

Tick (✓) **one** box.

much more than 2240 J ☐

2240 J ☐

much less than 2240 J ☐

(1)

(c) Another four students did the same experiment.

The measurements taken and the calculated values for power are given in the table.

Student	**Weight in newtons**	**Time taken in seconds**	**Power in watts**
A	285	3.8	240
B	360	2.4	480
C	600	3.4	560
D	725	4.0	580

(i) To make a fair comparison of their powers the students kept **one** variable in the experiment constant.

What variable did the students keep constant?

_____

(1)

(ii) From the data in the table a student wrote the following conclusion.

'The greater the weight of the student the greater the power developed.'

Suggest why this conclusion may **not** be true for a larger group of students.

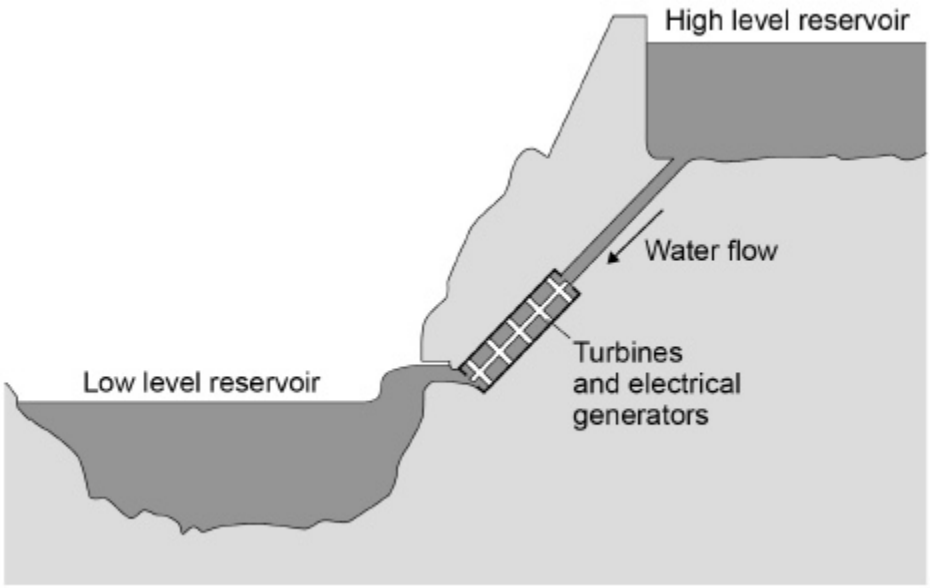
_____

_____

(1)

(Total 6 marks)

2 The diagram shows the flow of water through a hydroelectric power station.



The falling water turns the turbines.

The movement of the turbines causes the electrical generators to generate electricity.

(a) Write the equation which links kinetic energy, mass and speed.

_____

(1)

(b) In 1 minute, a mass of 9 000 kg of water flows through the turbines.

The speed of the water is 30 m/s

Calculate the total kinetic energy of the water passing through the turbines in 1 minute.

Give your answer in kilojoules (kJ).

_____

_____

_____

_____

Kinetic energy = _____ kJ

(3)

(c) Write the equation which links efficiency, total input energy transfer and useful output energy transfer.

_____

_____

(1)

(d) The efficiency of the turbines and generators is 80%

Calculate the useful output energy transfer from the hydroelectric power station in 1 minute.

Use your answer to part (b).

_____

_____

_____

_____

_____

Useful output energy transfer = _____ kJ

(3)

(e) A small group of people live in an area in the mountains.

The people plan to buy an electricity generating system that uses either the wind or the flowing water in a nearby river.

- The wind turbine costs £50 000 to buy and install.
- The hydroelectric generator costs £20 000 to buy and install.
- The average power output from the wind turbine is 10 kW
- The hydroelectric generator will produce a constant power output of 8 kW

Compare the advantages and disadvantages of the two methods of generating electricity.

Use your knowledge of energy resources and information given.

(4)

(Total 12 marks)

3 There are many different energy resources.

(a) Which **two** energy resources are renewable?

Tick **two** boxes.

- Biofuel ☐
- Coal ☐
- Gas ☐
- Geothermal ☐
- Nuclear fuel ☐

(2)

(b) Some non-renewable energy resources are more reliable than others.

Which statement correctly describes a reliable resource?

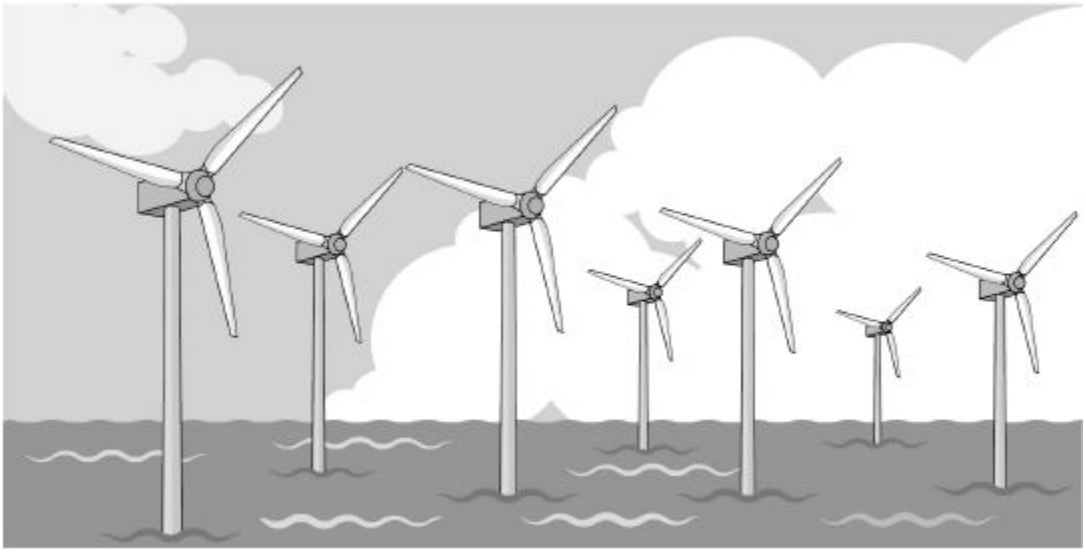
Tick **one** box.

- It does not burn fuel. ☐
- It is predictable. ☐
- It will never run out. ☐
- It is cheap to use. ☐

(1)

(c) **Figure 1** shows a wind farm.

Figure 1



The total power output of the wind farm is 19.6 MW

All of the wind turbines have the same power output.

What is the power output of **one** wind turbine?

Tick **one** box.

2.7 MW ☐

2.8 MW ☐

2.9 MW ☐

3.2 MW ☐

3.3 MW ☐

(1)

(d) Give **two** reasons why people might **not** like having wind turbines near their homes.

1. _____

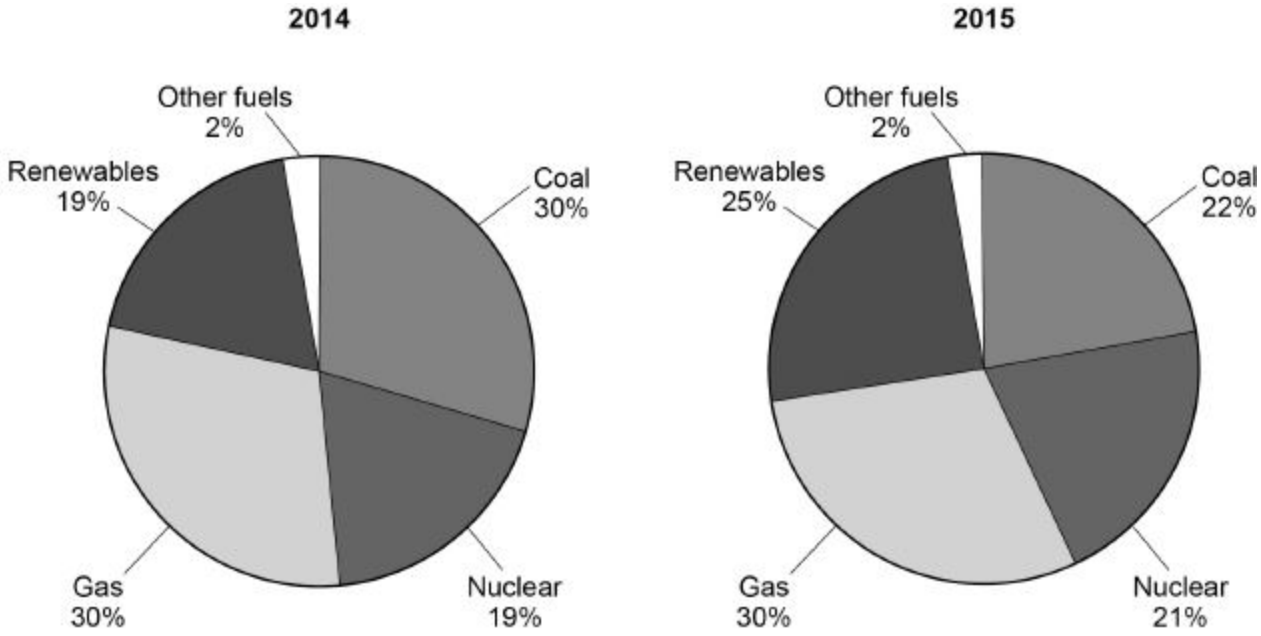
2. _____

(2)

(e) **Figure 2** shows the electricity generated by different energy resources in the UK.

The total amount of electricity generated was the same in 2014 and in 2015

Figure 2



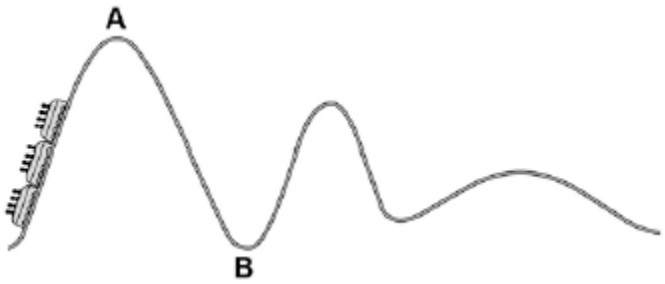
There are changes in the amounts of different energy resources used between 2014 and 2015

Explain the environmental impacts of the changes.

(4)

(Total 10 marks)

4 The figure below shows a rollercoaster.



The rollercoaster car is raised a vertical distance of 35 m to point **A** by a motor in 45 seconds.

The mass of the rollercoaster is 600 kg.

The motor has a power rating of 8 000 W.

(a) Calculate the percentage efficiency of the motor.

Gravitational field strength = 9.8 N / kg.

Efficiency = _____ %

(5)

(b) The rollercoaster rolls from point **A** to point **B**, a drop of 35 m.

Calculate the speed of the roller coaster at point **B**.

Assume that the decrease in potential energy store is equal to the increase in kinetic energy store.

Speed at point **B** = _____ m / s

(6)

(Total 11 marks)